

Dark matter and dark energy: problems and possible solutions

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We will introduce problems of Dark Matter (DM) and Dark Energy (DE), namely we will describe a development of these concepts and their present status. We will demonstrate approaches to these problems.

As specific issues we will discuss limits on DM concentration near the black hole at the Galactic Center and ways to solve DE problem introducing alternative theories of gravity such as $f(R)$ -theories.

The existence of dark matter (DM) at scales of few pc down to $\simeq 10^{-5}$ pc around the centers of galaxies and in particular in the Galactic Center region has been considered in the literature. Under the assumption that such a DM clump, principally constituted by non-baryonic matter (like WIMPs) does exist at the center of our galaxy, the study of the γ -ray emission from the Galactic Center region allows us to constrain both the mass and the size of this DM sphere. Further constraints on the DM distribution parameters may be derived by observations of bright infrared stars around the Galactic Center. Hall and Gondolo (2006) used estimates of the enclosed mass obtained in various ways and tabulated by Ghez et al. (2003, 2005). Moreover, if a DM cusp does exist around the Galactic Center it could modify the trajectories of stars moving around it in a sensible way depending on the DM mass distribution. Here, we discuss the constraints that can be obtained with the orbit analysis of stars (as S2 and S16) moving inside the DM concentration with present and next generations of large telescopes. In particular, consideration of the S2 star apoastron shift may allow improving limits on the DM mass and size.

We will describe severe constraints from Solar system data on parameters $f(R) = R^n$ theories, where $n = 1$ corresponds to the standard general relativistic case.

References

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